AUTOMATIC AND INTENTIONAL INHIBITION IN PATIENTS WITH GENERALIZED ANXIETY DISORDER

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ABSTRACT

The purpose of the present study was to investigate the effects of emotion on attention and memory in patients with generalized anxiety disorder (GAD). It has been hypothesized that an attentional bias for emotional stimuli is characteristic of a variety of anxiety disorders. This study used the emotional Stroop task and a modified directed forgetting task to investigate the effects of attentional and inhibitory biases on the processing of emotionally threatening stimuli in patients with GAD. Our data show that GAD patients have difficulties in identifying the colour of anxiety-related words in the emotional Stroop-task, and intentionally inhibiting anxiety-related items designated as “to be forgotten” in the directed forgetting task. Our conclusion is that GAD patients have an attentional bias and an intentional memory inhibition bias, which are both selective toward anxiety-related stimuli.

KEYWORDS: attentional bias, directed forgetting, intentional inhibition, anxiety.

INTRODUCTION

The relationship between cognitive processes and emotions has occupied an important place in the study of human behavior for a long time. Furthermore their interaction has been the subject of extensive investigations in

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psychopathology, for cognitive processes are thought to play a role in symptom production and maintenance, particularly in anxiety and affective disorders (Rapaport, 1971; Mathews & MacLeod, 1994; Eysenck, 1991; Williams et al., 1997; Kulas et al., 2002).

The purpose of the present study was to investigate the effects of anxiety-related emotions on executive processes. Emotions are functional because they signal events that are important for the organism and also prepare the body and mind to react to them (Tobby & Cosmides, 1990). From an adaptationist perspective, a well-designed cognitive system is likely to develop a preference for emotional signals (Murphy & Zajonc, 1993; Damasio, 1996; Roberts & Wallis, 2000; Bechara, Damasio, & Damasio, 2000).

However, the effectiveness of a cognitive system depends not only on the maintenance and organization of relevant information, but also on the successful inhibition of irrelevant information. Thus, the automatic and intentional inhibitions play an important role in executive processes.

There has been considerable interest in research into inhibitory biases for threat information in anxiety because recent cognitive theories have proposed that such biases may play a key role in the development and maintenance of clinical anxiety states. Cognitive models of anxiety propose that biases in processing threat-related information may cause or maintain clinical anxiety (e.g., Beck & Emery, 1985; Eysenck, 1991; Mogg et al., 1993; Williams & Oaksford, 1992; Williams et al., 1988, 1992, 1997). These models focus mainly on selective attentional processes because one function of anxiety is the detection of threat, enabling the individual to react quickly and adaptively.

In order to understand the cognitive biases of attention, psychological theories and clinical research have adapted information processing paradigms derived from experimental cognitive psychology. A classical paradigm for this purpose was originally introduced by Stroop (1935). The modified (i.e., emotional) version of the Stroop task is the paradigm most frequently used to investigate attentional biases in anxiety patients. In this task, participants are asked to name the ink color of words while ignoring their meaning. The basic finding is that, compared to other words and other participants, individuals with high anxiety are slow in naming the color of anxiety-relevant words (Matthews & MacLeod, 1994; Richards & Whittaker, 1990; Mogg & Marden, 1990; Mogg et al., 1990; Richards et al., 1992; Richards, 1995; Matthews & MacLeod, 1994; French et al., 1996; Williams et al., 1997; Mogg et al., 2000; Albu, 2005; Albu, 2007). Presumably, anxiety-relevant words have an emotional meaning, creating an attentional bias that interferes with the color-naming task, although the precise nature of this mechanism remains unclear.

The modified emotional Stroop task has been successfully used with a variety of anxiety patients, including patients with panic disorder (Ehlers et al., 1988; McNally et al., 1990; McNally et al., 1992), post-traumatic stress disorder (Foa et al., 1991; Kaspi et al., 1995), obsessive-compulsive disorder (Shoyer & Foa, 1991), specific phobia (Lavy et al., 1993), social phobia (Hope et al., 1990;
Becker et al., 2001), and patients with generalized anxiety disorder (Martin et al., 1991; Mogg et al., 1989; Bradley et al., 1995; Becker et al., 2001). Two competing explanations for the attentional biases observed in the emotional Stroop task are the general emotionality (positive or negative) theory vs. schema congruency or specificity theory. In their review, Williams et al. (1996) conclude that the emotional Stroop effect is not due to emotionality per se, but rather to the degree to which words are semantically related to the schema. Furthermore, by comparing interference indices over a variety of studies, they find that although “current concern” accounts for much of Stroop interference, it does not fully explain it in patient groups. Besides schema-relatedness, the negativity of the material is also important. Becker et al. (2001) found different attentional biases in their study: the attentional performance of patients with generalized anxiety disorder (GAD) was slowed by all types of emotional words, whereas patients with social phobia (SP) were specifically distracted by words related to the act of speaking. In light of this pattern of findings, the issue of how selective attentional biases are in different anxiety disorders is still under scrutiny.

Although the emotional interference effects found in emotional Stroop task are typically interpreted in terms of attention being preferentially allocated to the threat content, this interpretation is not entirely certain because the interference may not necessarily occur at the input stage of information processing, but it could also occur at later in the selection stage of the executive system.

In contrast with the Stroop task in which naming the colors of the words requires the automatic inhibition of the words’ meaning, there are other paradigms involving intentional inhibition, such as the directed forgetting (DF) paradigm (Bjork, 1968; Bjork & Woodward, 1973; Bjork, 1989). Research on intentional forgetting shows that people can forget certain information when they want, or they are instructed to forget. In a typical directed forgetting experiment, participants study a list of words with instructions to remember them for a later recall test. In one condition (Forget condition), participants are told to forget the words after they have learned them, and concentrate on learning a second list. In the other condition (Remember condition), participants are told to remember both lists of words. On a later recall test participants are asked to recall words from both lists, ignoring any previous instructions to forget. There are two consistent effects in this kind of task. First, participants in the Forget condition recall fewer words from the “to be forgotten” list, than those in the Remember condition, which is evidence of intentional forgetting. The second result is related to the better recall of words from the second list in the Forget condition, than its counterpart from the Remember condition. This finding provides evidence for the fact that participants in the Forget condition do not have the first list as a source of interference.

This pattern of results is called the directed forgetting (DF) effect, which can be explained by two possible mechanisms. Some theories emphasize selective remembering rather than selective forgetting. Bjork (1968, 1989) for example, has discussed the possibility that two interrelated processes might be operating during encoding, which could largely account for this pattern of findings. The alternative
explanation of the DF effect emphasizes the role of active, intentional and goal-oriented inhibition at the retrieval level (Bjork, 1989; Basden et al., 1993; Johnson, 1994; Racsmány & Conway, 2006). The DF effect in non-clinical populations was replicated in a large number of studies (Bjork, 1989; Basden et al., 1993; Johnson, 1994; Power et al., 2000; Conway et al., 2000; Albu, 2003), but under certain circumstances the inhibition ability can be impaired, such as after frontal lobe traumatic brain injuries (Conway & Fthenaki, 2003; Albu & Racsmány, 2005). There are a few studies that have examined intentional forgetting in the context of emotion, mainly concerning clinical disorders and coping styles. These studies have either found no DF effect, or only a diminished one in depressed participants (Power et al., 2000), schizophrenics (Racsmany et al., 2001; Racsmány et al., 2008), patients with obsessive-compulsive disorders (OCD), post-traumatic stress disorders (PTSD) (Cloitre, 1992; Wilhelm et al., 1996; Cloitre et al., 1996; Cloitre, 1998), and in patients with acute-stress disorders (ASD) (Moulds & Bryant, 2002; 2005). These studies indicated that the ability of intentional inhibition is impaired in anxious populations and this impairment is more profound when the “to be forgotten” information is threat-related. The issue of how selective this effect is in GAD patients remains, since no previous studies have investigated the emotional selectivity of the DF effect in this patient group.

The present study used the emotional Stroop task and the directed forgetting paradigm to investigate the interaction of inhibitory processes in attention and memory with threat-related stimuli. We have investigated these effects in a GAD group, on the assumption of a selective threat-related bias in their attention and memory functions. A novel feature of this study was that each subject was tested on two measures of inhibitory bias, so that we were able to examine, within the same sample of participants, whether the use of different tasks may explain the findings noted above. Another question on which we focused in the present study was the selectivity of inhibitory bias and the concept validity of tasks that are commonly used to measure this selective bias. We hypothesized that the same selective bias towards threatening stimuli could be observed in both tasks because automatic and intentional inhibition processes are executive functions and anxiety presumably influences the whole executive system.

**METHOD**

Many previous studies have shown impairments in the inhibitory function in clinical populations, but the comparison of the possible effects of anxiety in automatic and in intentional inhibition was somewhat ignored.

The main aim of our study was to investigate if anxiety was associated with selective biases resulting in high interference in the emotional Stroop task, and the effect of anxiety on inhibition processes in memory using a directed forgetting paradigm in GAD and normal populations.

In the later procedure a list of words is studied for later recall, then either a forgetting (F) instruction is given or participants are instructed to continue to
remember (R) the words from the first list while learning a second list. In the within-subject version, there are then four lists: Forget list 1 (F1), Forget list 2 (F2), Remember list 1 (R1) and Remember list 2 (R2). The standard DF effect is seen in poor recall of F list 1 relative to F list 2 and R list 1, and it is usually only found in free recall (MacLeod, 1998; Racsmány & Conway, 2006). Directed forgetting of the list is considered to entail inhibition of F list 1, rather than reduced rehearsal (Bjork, 1989; Bjork et al., 1998; Conway et al., 2000).

Participants

40 patients (aged between 23-60 years) were selected from the Neurology and Psychiatry Hospital and from the Rehabilitation Institute, Cluj-Napoca, Romania: 20 (14 women/6 men; mean age = 49.45) with clinically diagnosed GAD and 20 (8 women/12 men; mean age = 45.15) with no organic or psychiatric diseases. The potential GAD participants were given the “Structural Clinical Interview for DSM-III-R, UpJohn Version” (SCID-UP, Spitzer et al., 1987) by their clinical psychologist. Several potential participants were excluded due to medical illness, substance abuse and past or current psychotic episodes. The two groups were comparable in regards to their age, gender, and level of education (see the statistical analysis of subjects’ characteristics).

Materials

State-Trait Anxiety Inventory (STAI-I., II)

All participants completed the State-Trait Anxiety Inventory (STAI-I., II; Spielberger et al., 1970; translated and adapted in Romanian by Pitariu & Peleasa, 2007). We used Romanian normative data on STAI-I-II. (Lazar et al., personal communication) indicating a mean score in trait anxiety of 42.11 (7.04) in women, and one of 40.78 (8.33) in men. After excluding participants with near-median scores, we have selected a control group from those with a low trait anxiety score (mean trait < 35) in order to minimize the proportion of the sample with mid-range levels of state anxiety at the time of testing. The GAD patients scored well beyond the average score (> 40) (mean state score = 56.2; mean trait score =59.45), while for the control group we selected only subjects with low state and trait anxiety levels (mean state = 32.85; mean trait = 33.2).

Pilot study

The stimulus words used in experiments were selected and evaluated during a pilot study. A study list was prepared with 100 words, half of them supposedly threatening words and half of them supposedly neutral. All the words were matched for length (2-4 syllables) and frequency using norms on the internet (www.szoszablya.hu). All the words were rated by an independent group of 30 subjects on three dimensions: anxiety-generating, arousal, and valence. After analyzing all of these ratings, the 30 most and the 30 least threatening words were selected as stimulus materials (see appendix).
Emotional Stroop task

Stimulus cards were used to present the words for the emotional Stroop task. Six A4 cards were prepared, each comprised of 60 words, matched for word length and frequency. Each word was written in uppercase letters. One card consisted of rows of XXXXX (X. card), the next card was the standard Stroop interference card: the words red, blue, green, yellow were written 60 times in random order, with each word written in a color that differed from the word itself (S. card). The second card pair consisted of a selection of 2*30 emotionally neutral words (e.g. clock, flower) written with black ink (RN Card) or colored red, blue, green or yellow in random order (CN card). The final pair consisted of 2*30 anxiety related words (e.g., blood, shame) written with black ink (RA Card) or colored red, blue, green or yellow (CA Card).

DF lists

Twenty-eight unrelated common words were selected from the pre-selected stimulus-materials according to the following criteria: all the words had 2-4 syllables, they were semantically unrelated and had approximately equal word frequency. Fourteen of the words were neutral and fourteen were anxiety-related, and in the same list, no two words started with the same letter. The anxiety related words were assigned to F list 1 and R list 1, while F list 2 and R list 2 contained the neutral words. Two study booklets were prepared with each word printed on a separate card in upper-case black letters. The first study booklet contained two sets of to-be-remembered (TBR) words (seven words in each set) while the other study booklet contained a set of anxiety-related to-be-forgotten (TBF) words (seven words) and a set of neutral TBR words (seven words). The two booklets were rotated among participants to counterbalance presentation order. A 2-minute paper and pencil arithmetic task was administered between the study phase and recall.

Procedure

Participants were tested individually, and each session lasted approximately 30 minutes. Every session had three phases: subjects first completed the STAI-I, II, they then learned and recalled lists from the DF procedure, and finally they performed the emotional Stroop task.

For the Stroop task, the participants were instructed to read the words (RN and RA Cards) or name the color of the stimuli as quickly and as accurately as possible (S, X, CN, CA cards). The order of card presentation was determined randomly for each subject. The time spent on each of the stimuli was recorded and the mean time for each stimulus set was calculated.

The DF procedure consisted of three phases: (a) study, (b) a filled interval, (c) free recall. In the study phase, after the presentation of list 1, a remember (R cue) or a forget (F cue) was given; list 2 was always given with the Remember instruction. In the spoken free recall test, after a two minute filled interval, subjects were requested to try to remember the words previously seen in the study phase, regardless of which cue, R or F, had been originally given. The recall test was
terminated when the participant could not remember any more words, or when a 3-
minute interval had passed.

Participants were debriefed at the end of the study.

RESULTS AND DISCUSSION

Group characteristics

The low and high anxiety groups differed significantly in state anxiety
(mean = 56.2, SD = 7.3, vs. mean = 32.85, SD = 4.67, p < .01) and trait anxiety
(mean = 59.45, SD = 8.2, vs. mean = 33.2, SD = 4.06, p < .01), but not in age,
(mean = 49.45, SD = 3.0 vs. mean = 45.15, SD = 2.9, p < .01), or gender ratio
(male:female ratio was 8:12 in the low anxiety group and 6:14 in high anxiety
group, $\chi^2 = 0.01$, NS).

Emotional Stroop task

A 2 × 6 two-way ANOVA was carried out with one between-subjects
variable (groups) and one within-subjects variable (Stroop conditions) using the
reaction time (RT) as the dependent variable. A significant interaction effect
(F(1,38) = 4.94; p = 0.03) was found. This analysis also revealed a significant main
effect for the group variable (F(1,38) = 4.66; p = 0.03) and for the Stroop
conditions (F(1,38) = 9.19; p = 0.004).

When comparing the performances of the GAD and control groups there
were significant differences found in reading neutral words (RN) condition (t(38) =
2.28; p = 0.03), in naming the S card color (t(38) = 2.41; p = 0.02) and in anxiety-
related words contrasting (CA) condition (t(38) = 3.44; p ≤ 0.001) (see table 1).

Table 1
Comparison of global reaction times (sec.) in Emotional Stroop task

<table>
<thead>
<tr>
<th>Emotional Stroop cards</th>
<th>GAD group</th>
<th>Control group</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RN</td>
<td>36.03 (20.86)</td>
<td>23.16 (15.21)</td>
<td>2.28 *</td>
</tr>
<tr>
<td>RA</td>
<td>37.41 (22.03)</td>
<td>25.79 (23.77)</td>
<td>1.60</td>
</tr>
<tr>
<td>X</td>
<td>31.23 (12.40)</td>
<td>23.15 (8.42)</td>
<td>2.41*</td>
</tr>
<tr>
<td>S</td>
<td>61.13 (18.69)</td>
<td>52.01 (22.89)</td>
<td>1.38</td>
</tr>
<tr>
<td>CN</td>
<td>34.04 (10.62)</td>
<td>30.73 (8.45)</td>
<td>0.376</td>
</tr>
<tr>
<td>CA</td>
<td>41.77 (11.58)</td>
<td>34.04 (10.62)</td>
<td>3.44**</td>
</tr>
</tbody>
</table>

*p < 0.05; ** p < 0.01
We calculated two interference indices: the standard Stroop interference index, by subtracting RTs for X cards from RTs for S-cards, and by subtracting RTs for CN-RN cards from RTs for CA-RA cards. When comparing the standard Stroop interference indices using independent t-tests, no significant differences were found \((t(38) = 0.19; p = 0.4)\) (see figure 1).

![Figure 1](image1.png)

Comparison of standard interference effect in Stroop task

The comparison of emotional Stroop interference index revealed a significant difference \((t(38) = 7.35; p \leq 0.001)\) between groups (see figure 2).

![Figure 2](image2.png)

Comparison of emotional interference effect in emotional Stroop-task
These results indicate a strong emotional interference effect in GAD group.

**DF paradigm**

A 2 x 2 two-way ANOVA was carried out with groups as between-subjects variable and instruction type (R or F cue) as within-subjects variable, using the recall rate as the dependent variable.

Table 2

*Comparison of recalled words rate in DF task*

<table>
<thead>
<tr>
<th>Groups</th>
<th>Forgetting condition</th>
<th>Remembering condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F1 list</td>
<td>F2 list</td>
</tr>
<tr>
<td>GAD group</td>
<td>44.37 (15.42)</td>
<td>38.75 (19.42)</td>
</tr>
<tr>
<td>Control group</td>
<td>30 (14.04)</td>
<td>45.62 (11.48)</td>
</tr>
<tr>
<td>t-value (p)</td>
<td>3 (0.005)</td>
<td>2.069 (0.04)</td>
</tr>
</tbody>
</table>

The two critical differences to show a DF effect are: a reliable greater recall of R list 1 and F list 2 compared to F list 1. By analyzing separately the DF effect on each group, the control group had both critical comparisons that were significant in the expected way (F1 - F2: t(19) = 10.63; p ≤ 0.001; respectively F1 - R1: t(19) = 9.29; p ≤ 0.001). This finding indicates a normal DF effect in the control group. For the GAD group, the first comparison was not significant (t(19) = 1.87; p = 0.5), while the second was a significant comparison (t(19) = -2.78; p = 0.01). This suggests a rebound effect in which items targeted for inhibition are recalled to an unexpectedly high level (see Table 2 where the recall of F list 1 is significantly higher than the recall of F list 2).

Two inhibition indices were calculated: the standard DF inhibition index, by subtracting for each participant F list 1 from R List 1 and emotional DF inhibition index by subtracting F list 1 from F List 2 in the F-R free recall condition for each participant. Mean values equal to zero or lower indicate no inhibition.

The standard DF inhibition index was compared with the independent t-test (see Figure 3) and a significant difference was found (t(38) = 5.67; p ≤ 0.001), with the GAD group showing lower inhibition.

Comparing the emotional DF effect we found a significant difference (t(38) = 8.5; p ≤ 0.001) between groups. Only the control group showed inhibition, while the GAD group had a negative inhibition index.
Influence of anxiety on the automatic and intentional inhibition bias

As mentioned before, GAD patients had higher scores than control participants on STAI-I,II. In order to determine the effects of anxiety, questionnaire scores were correlated with automatic inhibition bias scores (i.e., emotional Stroop interference index calculated above) and with intentional inhibition bias scores (reversed emotional DF effect: subtracting F list 2 from F list 1 in the F-R free recall condition). The state- and trait anxiety scores correlated significantly (r = 0.81; p = 0.01), indicating that GAD patients experienced higher levels of state-anxiety during the experiment than the control participants. In light of the pattern of findings earlier reported, it is not surprising that the automatic inhibition bias score correlates significantly with state-anxiety scores (r = 0.38; p=0.01) and with trait-anxiety (r = 0.46; p <0.01). Similarly, the intentional inhibition score showed significant and stronger correlations with state-anxiety (r = 0.74, p <0.01) and trait-anxiety (r=0.75, p <0.01), respectively. The two inhibition bias scores also showed a significant correlation (r = 0.38; p= 0.01), indicating a relation between automatic and intentional inhibition bias.

In summary, the data indicates that GAD patients show difficulties in identifying the color of anxiety-related words, even though they were explicitly instructed to ignore the semantic content of the words. This finding is in agreement with previous studies demonstrating a selective bias towards the processing of the threat-related stimuli in anxiety. The GAD patients not only showed a significant interference effect, they were also somewhat slower in all conditions - especially in reading neutral words and naming colors. This may be due to the generally slowed information processing – but note that the control group also included participants from other clinical populations – in psychiatric diseases. However, a significant
difference between groups was found only in interference conditions, demonstrating impaired inhibition.

This study also indicates that patients with GAD were not able to intentionally inhibit anxiety-related items designated as “to be forgotten”. In contrast, a rebound effect was observed: they recalled significantly more anxiety-related words despite the fact that these words were associated with the F-cue. On the other hand, the control patients experienced normal DF effect. Thus from this study it can be concluded that in addition to attention bias, GAD patients have intentional memory inhibition bias which is selective toward anxiety related stimuli.

**DISCUSSION**

One of the aims of this study was to investigate the selectivity of inhibitory bias, as well as the generality of this selective bias in two inhibition paradigms. The results are in line with previous studies, indicating lower inhibition ability in the GAD group. The GAD patients showed a selective interference effect toward threat-related stimuli in the emotional Stroop-task. Despite the fact that the GAD group was generally slower in all interference conditions and they displayed more errors, these differences were significant only in threat-related interference conditions. This finding is in accordance with Eysenck’s (1991) theory arguing that the attention focus of anxious patients is more easily distractible, most likely because they perceive various stimuli as potential dangers, requiring an extra processing effort for threatening stimuli. Matthews and MacLeod (1994) propose that threat-related material shows an enhanced ability to capture the attentional system in anxious individuals, and previous research on selective attention shows that emotional stimuli capture attention quickly and involuntarily. The present study offers support for this hypothesis, suggesting that anxiety-prone individuals have rather undifferentiated cognitive representations of threat (danger schemata) that are easily activated by the presence of danger-relevant cues, resulting in a selective allocation of processing resources toward such information (Beck & Clark, 1991).

In the DF task no directed forgetting effect was found in the GAD group, while in the clinical control group the DF effect was normal. In the forgetting condition, GAD patients recalled significantly more words from the F list 1 than the control subjects who recalled significantly more words from the F list 2. In the remembering condition, the results were different from the forgetting condition: the control subjects recalled significantly more words from both R1 and R2 lists, compared with GAD group. Results also indicate that the GAD group could not intentionally forget the emotionally salient, previously learned material. These results are in accordance with some previous studies showing no directed forgetting effect in clinical populations (Wilhelm et al., 1996; Cloitre, 1998; Conway & Fthenaki, 2003; Albu & Racsmány, 2005; McDonald et al., 2006),
suggesting that affective experience undermines forgetting, but they do not identify mechanisms for the effect.

The retrieval-inhibition theory of intentional forgetting outlines two critical processes (Bjork, 1989). The first is the mental segregation of “to be forgotten” items from “to be remembered” items. The second process is retrieval inhibition - intentionally reducing activation for memory (Anderson et al., 1994). Intentionally forgotten events are not erased from memory, but access to them is blocked. Emotions might intervene at either step. Because emotional items are processed more elaborately than neutral items, participants might form more links between emotional items and other memories, in concordance with Bower’s (1981) emotional network theory, which reduces the segregation between “to be forgotten” and “to be remembered” items. Emotion may also interfere with retrieval inhibition because emotion renders events saliently, and therefore they are highly accessible.

Another interesting finding was that GAD patients generally showed a lower recall rate both in forgetting and in remembering conditions. This can be explained with a possible smaller working memory capacity due to the extra processing resources required by threat-related stimuli (West, 1999), resulting also in a selective goal-neglect process (Duncan, 1993; Duncan et al., 1996).

In our study GAD patients recalled more threatening “to be forgotten” words suggesting that in addition to emotionally selective bias in the GAD group, an effect that Wegner (1994; Wegner & Gold, 1995) referred to as “ironic mental” control, must also be considered. This phenomenon suggests the possibility of a common mechanism in which the attempts to inhibit threat- or aversive personally relevant information lead to greater facilitation of intrusions into consciousness. This effect may also possibly explain some of the intrusive phenomena that are seen in post-traumatic stress disorder in which attempts to avoid distressing thoughts related to trauma often seem to lead to more rather than less experience of the intrusions (e.g., Power & Dalgleish, 1997; Power et al., 2000).

Given its potential clinical relevance, intentional forgetting has been suggested as one way that people may replace troubling memories with happier ones (Bjork et al., 1998). Our findings contribute to the question of whether forgetting can be helpful in some situations (e.g., coping with traumatic experiences); though caution is needed in generalizing from the mild emotions of the laboratory to the intense emotion that can characterize the real life (e.g., trauma). These comments are of course speculative, but they suggest interesting further exploration of these phenomena. Theories that include intentional forgetting of emotional memories may need to specify how this forgetting is accomplished and how a coping strategy manages to overcome the basic advantages that emotional events have in attention and memory.

The results of this study show that while the emotional Stroop task is suitable for examining emotionally selective bias in attention processes, the directed forgetting task is an ideal one to extend both the investigation of the interaction of cognition and emotion and for examining the inhibitory effects in
normal and in different clinical populations. Our main findings and the correlation between automatic and intentional inhibition tasks indicate that emotion may interfere at a higher level with the cognitive processes. Since automatic and intentional inhibition processes are considered as sub-processes of the executive system it seems plausible that anxiety may interfere with the whole executive system. A number of questions remain to be answered by future experiments. For example, are the effects shown by GAD patients in this study due to a wider anxiety schema? What kind of material is most specific for individual anxiety disorder? Can these selective biases toward threatening material be observed in another experimental and clinical tasks depending on executive system functioning?

Whatever the answers to these questions may be, experimental paradigms derived from cognitive psychology such as Stroop task and DF paradigm will be helpful in investigating selective cognitive processes in emotional disorders. In particular, it seems worthwhile to assess the diagnostic value of the emotional Stroop task and emotional DF task for determining the severity of anxiety and other clinical disorders and their value for predicting therapy outcome.

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